

What is claimed is:

- 1 1. An apparatus comprising:
2 an error filter coupled to an adaptive filter having N taps to filter a decision error
3 provided by the adaptive filter using a leakage factor; and
4 an updater coupled to the error filter and the adaptive filter to update N equalizer
5 coefficients to the N taps using the filtered decision error, the updater receiving N
6 equalizer data from the N taps.

- 1 2. The apparatus of claim 1 wherein the error filter is a high pass filter.

- 1 3. The apparatus of claim 1 wherein the error filter is a first-order high pass
2 filter having a pole determined by the leakage factor.

- 1 4. The apparatus of claim 1 wherein the error filter has a zero at zero
2 frequency.

- 1 5. The apparatus of claim 1 wherein the error filter comprises:
2 a first computing element to compute an error difference of the decision error; and
3 a second computing element coupled to the first computing element to generate
4 the filtered decision error using the leakage factor.

- 1 6. The apparatus of claim 5 wherein the first computing element comprises:
2 a delay element to delay the decision error; and
3 a subtractor to subtract the delayed decision error from the decision error to
4 provide the error difference.

- 1 7. The apparatus of claim 5 wherein the second computing element
2 comprises:
3 a delay element to delay the filtered decision error to provide a delayed output;
4 a multiplier coupled to the delay element to multiply the leakage factor with the
5 delayed output to generate a product; and

6 an adder coupled to the multiplier to add the error difference to the product to
7 generate the filtered decision error.

1 8. The apparatus of claim 1 wherein the updater comprises:
2 N coefficient updaters coupled to the error filter to generate the updated equalizer
3 coefficients using the N equalizer data and the filtered decision error.

1 9. The apparatus of claim 8 wherein each of the N coefficient updaters
2 comprises:
3 a first multiplier to multiply a corresponding one of the equalizer data with the
4 filtered decision error to provide a first product;
5 a second multiplier coupled to the first multiplier to multiply the first product with
6 an adaptive step size to provide a second product;
7 a delay element to delay a corresponding one of the updated equalizer coefficients
8 to provide a delayed coefficient; and
9 a subtractor coupled to the second multiplier and the delay element to subtract the
10 second product from the delayed coefficient, the subtractor providing the updated filtered
11 coefficient.

1 10. The apparatus of claim 6 wherein the delay element delays the decision
2 error by one sample.

1 11. The apparatus of claim 7 wherein the delay element delays the filtered
2 decision error by one sample.

1 12. A method comprising:
2 filtering a decision error provided by an adaptive filter using a leakage factor, the
3 adaptive filter having N taps; and
4 updating N equalizer coefficients to the N taps using the filtered decision error by
5 an updater, the updater receiving N equalizer data from the N taps.

1 13. The method of claim 12 wherein filtering the decision error comprises
2 filtering the decision error by a high pass filter.

3 14. The method of claim 12 wherein filtering the decision error comprises
4 filtering the decision error by a first-order high pass filter having a pole determined by the
5 leakage factor.

1 15. The method of claim 12 wherein filtering the decision error comprises
2 filtering the decision error by a first-order high pass filter having a zero at zero frequency.

1 16. The method of claim 12 wherein filtering the decision error further
2 comprises:
3 computing an error difference of the decision error by a first computing element;
4 and
5 generating the filtered decision error using the leakage factor.

1 17. The method of claim 16 wherein computing the error difference
2 comprises:
3 delaying the decision error; and
4 subtracting the delayed decision error from the decision error to provide the error
5 difference.

1 18. The method of claim 16 wherein generating the filtered decision error
2 further comprises:
3 delaying the filtered decision error to provide a delayed output;
4 multiplying the leakage factor with the delayed output to generate a product; and
5 adding the error difference to the product to generate the filtered decision error.

1 19. The method of claim 12 wherein updating the N equalizer coefficients to
2 the N taps comprises:

3 generating the updated equalizer coefficients using the N equalizer data and the
4 filtered decision error.

1 20. The method of claim 19 wherein generating the updated equalizer
2 coefficients comprises:

3 multiplying a corresponding one of the equalizer data with the filtered decision
4 error to provide a first product;

5 multiplying the first product with an adaptive step size to provide a second
6 product;

7 delaying a corresponding one of the updated equalizer coefficients to provide a
8 delayed coefficient; and

9 subtracting the second product from the delayed coefficient to provide the updated
10 filtered coefficient.

1 21. The method of claim 17 wherein delaying the decision error comprises
2 delaying the decision error by one sample.

1 22. The method of claim 18 wherein delaying the decision error comprises
2 delaying the filtered decision error by one sample.

1 23. A computer program product comprising:

2 a machine useable medium having program code embedded therein, the program
3 code comprising:

4 computer readable program code to filter a decision error provided by an
5 adaptive filter using a leakage factor, the adaptive filter having N taps; and

6 computer readable program code to update N equalizer coefficients to the
7 N taps using the filtered decision error by an updater, the updater receiving N equalizer
8 data from the N taps.

1 24. The computer program product of claim 23 wherein the computer readable
2 program code to filter the decision error comprises computer readable program code to
3 filter the decision error by a high pass filter.

1 25. The computer program product of claim 23 wherein the computer readable
2 program code to filter the decision error comprises computer readable program code to
3 filter the decision error by a first-order high pass filter having a pole determined by the
4 leakage factor.

1 26. The computer program product of claim 23 wherein the computer readable
2 program code to filter the decision error comprises computer readable program code to
3 filter the decision error by a first-order high pass filter having a zero at zero frequency.

1 27. The computer program product of claim 23 wherein the computer readable
2 program code to filter the decision error comprises:
3 computer readable program code to compute an error difference of the decision
4 error; and
5 computer readable program code to generate the filtered decision error using the
6 leakage factor.

1 28. The computer program product of claim 27 wherein the computer readable
2 program code to compute the error difference comprises:
3 computer readable program code to delay the decision error; and
4 computer readable program code to subtract the delayed decision error from the
5 decision error to provide the error difference.

1 29. The computer program product of claim 27 wherein the computer readable
2 program code to generate the filtered decision error further comprises:
3 computer readable program code to delay the filtered decision error to provide a
4 delayed output; and
5 computer readable program code to multiply the leakage factor with the delayed
6 output to generate a product; and
7 computer readable program to add the error difference to the product to generate
8 the filtered decision error.

1 30. The computer program product of claim method of claim 23 wherein the
 2 computer readable program code to update the N equalizer coefficients to the N taps
 3 further comprises:
 4 computer readable program code to generate the updated equalizer using the N
 5 equalizer data and the filtered decision error.

1 31. The computer program product of claim 30 wherein the computer readable
 2 program to generate the updated equalizer coefficients comprises:
 3 computer readable program code to multiply a corresponding one of the equalizer
 4 data with the filtered decision error to provide a first product;
 5 computer readable program code to multiply the first product with an adaptive
 6 step size to provide a second product;
 7 computer readable program code to delay a corresponding one of the updated
 8 equalizer coefficients to provide a delayed coefficient; and
 9 computer readable program code to subtract the second product from the delayed
 10 coefficient to provide the updated filtered coefficient.

1 32. The computer program product of claim 28 wherein the computer readable
 2 program code to delay the decision error comprises computer readable program code to
 3 delay the decision error by one sample.

1 33. The computer program product of claim 29 wherein the computer readable
 2 program code to delay the decision error comprises computer readable program code to
 3 delay the filtered decision error by one sample.

1 34. A system comprising:
 2 an adaptive filter having N taps with N equalizer coefficients to generate an output
 3 sequence from an input signal, the adaptive filter generating an error decision; and
 4 a tap-leakage generator coupled to the adaptive filter comprising:
 5 an error filter coupled to an adaptive filter having N taps to filter the
 6 decision error using a leakage factor; and

7 an updater coupled to the error filter and the adaptive filter to update N
8 equalizer coefficients to the N taps using the filtered decision error, the updater receiving
9 N equalizer data from the N taps.

1 35. The system of claim 34 wherein the error filter is a high pass filter.

1 36. The system of claim 34 wherein the error filter is a first-order high pass
2 filter having a pole determined by the leakage factor.

1 37. The system of claim 34 wherein the error filter has a zero at zero
2 frequency.

1 38. The system of claim 34 wherein the error filter comprises:
2 a first computing element to compute an error difference of the decision error; and
3 a second computing element coupled to the first computing element to generate
4 the filtered decision error using the leakage factor.

1 39. The system of claim 38 wherein the first computing element comprises:
2 a delay element to delay the decision error; and
3 a subtractor to subtract the delayed decision error from the decision error to
4 provide the error difference.

1 40. The system of claim 38 wherein the second computing element comprises:
2 a delay element to delay the filtered decision error to provide a delayed output;
3 a multiplier coupled to the delay element to multiply the leakage factor with the
4 delayed output to generate a product; and
5 an adder coupled to the multiplier to add the error difference to the product to
6 generate the filtered decision error.

1 41. The system of claim 34 wherein the updater comprises:
2 N coefficient updaters coupled to the error filter to generate the updated equalizer
3 coefficients using the N equalizer data and the filtered decision error.

1 42. The system of claim 41 wherein each of the N coefficient updaters
 2 comprises:
 3 a first multiplier to multiply a corresponding one of the equalizer data with the
 4 filtered decision error to provide a first product;
 5 a second multiplier coupled to the first multiplier to multiply the first product with
 6 an adaptive step size to provide a second product;
 7 a delay element to delay a corresponding one of the updated equalizer coefficients
 8 to provide a delayed coefficient; and
 9 a subtractor coupled to the second multiplier and the delay element to subtract the
 10 second product from the delayed coefficient, the subtractor providing the updated filtered
 11 coefficient.

1 43. The system of claim 39 wherein the delay element delays the decision
 2 error by one sample.

1 44. The system of claim 40 wherein the delay element delays the filtered
 2 decision error by one sample.